

# Idle Reduction Technology Demonstration Plan

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**National Renewable Energy Laboratory**

1617 Cole Boulevard  
Golden, Colorado 80401-3393

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Prepared under Task No. FC03.0730



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## Background

The U.S. Department of Energy's (DOE) Advanced Vehicle Testing Activity (AVTA) initiated a study of diesel truck engine idle reduction (IR) technologies and the needs of the trucking industry for using these technologies to reduce fuel use and emissions. IR includes methods and technologies that provide alternatives for cabin heating and cooling, maintaining engine and fuel system warmth for easy startup, and providing electricity for other amenities—activities that usually require the truck engine to idle. IR technology consists of onboard auxiliary units, including direct-fired heaters and auxiliary power units (APUs), and offboard truck stop electrification (TSE) equipment that supply electric power for heating, ventilation, and air conditioning (HVAC).

Even though some analysis indicates a possible two-year payback in fuel savings alone, feedback from preliminary discussions and study results indicates that initial cost is a major, if not the most important factor, for limited market penetration of current IR technologies. Other barriers reported include driver education, training and overall receptiveness, and issues related to reliability and maintenance requirements. The purpose of this Demonstration Plan is to define a pathway to IR technology implementation and use by addressing these issues. The intended outcome of this demonstration and evaluation is to identify and remove barriers for the targeted use of IR technologies in trucking applications. Objective analysis of this evaluation activity will provide truck operators with unbiased information on IR technology upon which they can base their purchasing decisions. Positive results will encourage truck operators to demand these systems and motivate truck manufacturers to integrate and install IR as standard equipment.

### Reducing Diesel Truck Idling

Heavy-duty trucks are excellent candidates for IR technology because many operate at idle 30% to 50% or more of the time. An engine in a truck without IR equipment may need to idle to heat or cool the cab. During the winter, the engine may need to be idled to keep the engine, oil, and fuel warm for easier starting. At low temperatures, diesel fuel can gel in the tank and fuel lines, plugging the filter and fuel system.

Diesel engine idling increases fuel consumption, engine wear, and required engine maintenance. The fuel consumption for diesel trucks at idle is typically 0.8–1.5 g/hr, depending on the engine size, ambient temperature, and load for HVAC and other electrical loads. Idling also causes undesirable emissions. The average emissions for heavy-duty diesel engines are shown in Table 1.

**Table 1. Heavy-Duty Diesel Engine Emissions at Idle (g/hr)**

Emission	Heavy-Duty Diesel
Volatile Organic Compound (VOC)	12.6
Carbon Monoxide (CO)	94.6
Oxides of Nitrogen (NO <sub>x</sub> )	144*
Particulate Matter (PM)	2.57
Carbon Dioxide (CO <sub>2</sub> )	8,224*

Sources: Environmental Protection Agency (EPA) Web site:

[www.epa.gov/OMS/consumer/f98014.htm](http://www.epa.gov/OMS/consumer/f98014.htm) (April 1998) and

\* <http://www.epa.gov/otaq/retrofit/documents/r02025.pdf> (October 2002)

Heavy-duty trucks are typically parked and idled so the driver can rest at truck stops and roadside rest areas instead of checking into a motel. These stops can have hundreds of trucks idling in the parking area at once. Diesel-powered trucks at idle produce noise, vibrations, and emissions that affect drivers, other

truck stop or rest area patrons, and neighbors. Many places in the United States (especially metropolitan areas) have laws (not always strongly enforced) that prohibit or restrict the idle time of heavy-duty trucks. Truck companies and owner-operators endeavor to comply with these laws, while keeping drivers comfortable, and lowering operating costs.

### IR Technology Status

The trucking industry has been using various forms of IR for some time. Many are as simple as enabling the engine control system to shut the engine off if it idles longer than a set length of time. In northern states, some over-the-road trucks have fuel-fired heaters for the cold nights. Special inverter (AC to DC power) kits that allow the truck to be plugged into an AC outlet are commercially available. These devices have been used to reduce fuel consumption and save on operating costs in limited applications.

Better-designed, higher-impact solutions are available to reduce diesel truck idling by providing auxiliary power for heating, cooling, and accessories. But interest in these more sophisticated IR technologies is also limited in the trucking industry. Onboard auxiliary units (such as APUs) have a high initial cost and add weight, maintenance, and complexity. Electric power provided at parking locations requires expensive infrastructure and usually requires additional onboard equipment.

A successful implementation of IR technology will require a demonstrated reduction in fuel and other operating costs with minimal equipment costs. Table 2 lists the average truck operations costs for all heavy-duty truck vocations. Further cost reductions could be realized if truck maintenance was reduced by less engine idling—extremely important when considering that the average margin of profit for a trucking firm is 2% to 3%. In fact, recent analysis by DOE's Argonne National Laboratory (Report ANL/ESD-43, June 2000) has shown significant financial savings opportunities with widespread introduction of more auxiliary power type IR technologies. Although the analysis is positive and encouraging, limited utilization of IR technologies has resulted in a lack of comparative data on the performance of these technologies in operation.

**Table 2. Average Truck Operations Cost for All Vocations  
(Operating Year 2000)**

Operating Category	Percent of Total Cost
Wages, Salaries, Fringe	45.4
Fuel, Oil, Lubrications	6.2
Maintenance and Supplies	6.1
Insurance	2.4
Equipment Costs and Taxes	20.5
Other Miscellaneous	19.4
<b>Total</b>	<b>100.0</b>

Source: American Trucking Associations (ATA), Motor Carrier Annual Reports 2000, TT Press, 2002

Table 3 lists many commercial products available for IR in trucking. Each technology has an estimated diesel fuel consumption of less than 0.3 g/hr (manufacturer data), which is much lower than the 0.8–1.5 g/hr fuel consumption of a typical heavy-duty diesel engine at idle.

**Table 3. Summary of Available IR Equipment**

<b>Manufacturer</b>	<b>Model and Type</b>	<b>Diesel Gallon/Hour Consumption</b>	<b>Price Range Estimate</b>
<b>Fuel-Fired Heaters</b>			
Espar Heater Systems	Several models and sizes of fuel-fired heaters and engine coolant heaters	0.05	\$1,300–\$2,600
Teleflex Ltd./ProHeat	X45 model is only a heater for the cab	0.1	\$2,000
Webasto Thermosystems, Inc.	Several models of heaters and coolant heaters available	0.03–0.24	\$1,000–\$2,500
<b>Auxiliary Power Units</b>			
Aura Systems, Inc.	AuraGen products provide onboard power generation from the engine or vehicle battery	0 (electric from engine or battery)	\$7,000
AUX Generators Inc.	Two models (AUX power systems and GENAUX 2000), provide power and HVAC in cab, uses small Kubota diesel engine	0.3	\$6,000–\$7,000
Double Eagle Industries	The Gen-Pac model provides HVAC and power, uses Kubota diesel engine	0.3	\$8,500 with air conditioning
Frigette Truck Climate Systems	Three models provide for HVAC in the cab and two of those models provide power to the cab, uses Kubota engine	0.1–0.2	\$6,000–\$7,500
Pony Pack, Inc.	Pony Pack APU provides power and HVAC, uses Kubota engine	0.2	\$5,600
RigMaster Power	Provides separate HVAC and power to cab, uses Perkins diesel engine	0.2	\$5,300
Teleflex Ltd./ProHeat	I.C.E. Gen 3 provides HVAC and power to the cab, Kubota engine	0.1–0.3	\$3,000
Truck Gen, Inc.	Provides power generation in 3.5 kW and 5.5 kW sizes and APU with power and HVAC for cab, all three use Kubota engines	0.1–0.2	\$5,000–\$6,500
Willis Auxiliary Power Dynamics, LLC	APU replaces battery pack so that only one 12V battery is required, provides power and HVAC to cab, uses Kubota engine	0.25	\$6,500
<b>Truck Stop Electrification</b>			
Idle Aire Technologies Corp.	Provides power, telecommunications, and HVAC at truck stop as a unit that fits into the window, two installations on New York Thruway and one in development in Tennessee	N/A	\$9–\$12 per night
Phillips	ElectroLink Kit for the truck to allow 110 V AC plug in with inverter for onboard DC power	N/A	\$2,200
Xantrex	Kit for the truck to allow 110 V AC plug in with inverter for onboard DC power	N/A	\$2,000–\$4,000

(Source: EPA Web site, [www.epa.gov/otaq/retrofit/idling.htm](http://www.epa.gov/otaq/retrofit/idling.htm))

## Objective and Approach

The goal of this demonstration and evaluation effort is to gather objective in-use information on the performance of available IR technologies by characterizing the cost; fuel, maintenance, and engine life savings; payback; and user impressions of various systems and techniques. The initial step has been to assess the needs and motivation of the trucking industry and independent truck operators to identify technologies that may have the greatest impact on reducing engine idling time and its associated fuel use.

Once identified, select IR systems will be installed on truck fleets of various sizes and geographic locations and monitored for in-use performance. The data collected will be used to identify and develop solutions to widespread implementation. All information and reports of technology performance will be shared with interested parties to encourage and facilitate the use of IR technologies.

Previous studies and analyses have shown some operational cost and emission reduction potential by reducing truck idling through existing technologies, but there are limited published in-use data on currently available IR technologies that quantify these potential savings. Demonstration, documentation of performance and cost savings, and information dissemination are necessary to convince truck manufacturers, fleets, and operators of the benefits of IR technologies. The EPA has projects underway to demonstrate offboard TSE, so, to avoid duplication of effort, the AVTA will focus on onboard IR technology demonstration projects. Systems that use APUs (which provide electricity for heat, cooling, and other electrical accessories such as microwaves and laptop computers) are ideal candidates for this Demonstration Plan. However, DOE is interested in all onboard IR strategies and has not yet eliminated any candidate technologies.

### **Support for 21<sup>st</sup> Century Truck Partnership**

The vision of the 21<sup>st</sup> Century Truck (21CT) Partnership's is for our nation's trucks and buses to safely and cost-effectively move larger volumes of freight and passengers, while emitting little or no pollution and reducing U.S. dependence on foreign oil. The partnership's strategic approach includes promoting development and deployment of technologies that substantially reduce energy consumption and exhaust emissions during idling. Specific IR technology goals are to:

- Develop and demonstrate by 2007 a commercially viable 5 kW, \$200/kW, diesel-fueled internal combustion engine APU (0.2 diesel fuel g/hr, 200 lbs. weight; 0.5 cu. meter size; 65 decibels noise level; meets emission standards; integrates cooling and fueling systems; and meets the noise, vibration, harshness (NVH) of the prime mover).
- Develop and demonstrate a commercially viable fuel cell APU system in the 5-30 kW range capable of operating on diesel fuel at a delivered cost of \$400/kW by 2012.

In support of the 21CT Partnership, AVTA IR demonstration projects will benchmark current IR technology options and lay the groundwork for future demonstrations by identifying viable partners and methods. The AVTA demonstration projects will also provide data to baseline the present onboard IR technology options, identify necessary technology improvements, and focus 21CT development activities on IR technologies that will have the greatest impact on IR acceptance and utilization. The demonstration results and information collected (including driver behavior) will help define the criteria most important for fleet and driver acceptance. The Government and Industry teams formed to carry out the AVTA demonstration of currently available IR technology options will establish the experience and methodology necessary for future successful IR technology demonstrations.

### **DOE Solicitation**

DOE intends to issue a solicitation requesting proposals to demonstrate and evaluate IR technology. We anticipate awarding projects to fleets or owner-operators assembled into teams with support from truck and IR technology manufacturers. All onboard IR technologies will be considered, but the technologies and projects with the greatest impact will be chosen first. Projects with the greatest impact will use available IR technology and have the highest probability of integration at the truck manufacturer level (i.e., a truck manufacturer, as part of a proposed project team, will be willing to design the installation and offer the proposed technology as standard equipment upon positive results of the in-use evaluation).

To meet the objectives of this project, the Demonstration Plan consists of five phases:

**Phase 1:** Initial needs assessment (completed early 2003)

**Phase 2:** Workshop for industry input (mid 2003)

**Phase 3:** Solicitation and award of demonstration projects (mid 2003)

**Phase 4:** In-use evaluations (late 2003/early 2004)

**Phase 5:** Data analysis and dissemination (late 2004)

## **Phase 1 – Initial Needs Assessment**

The purpose of the initial needs assessment was to characterize operational needs and barriers to the use of IR technologies in the heavy-duty truck fleet through discussions and interviews with industry representatives. This phase was completed in February 2003. Additionally, these interviews were used to gauge and document respondents' interest in participating in demonstration projects. Industry representatives include fleet managers, independent owner-operators, truck manufacturers, and IR technology manufacturers. Participants in the needs assessment included members of the American Trucking Associations (fleet managers), members of the Owner-Operator Independent Drivers Association (owner-operators), truck manufacturers (Freightliner, Mack, PACCAR, Volvo), and many IR technology manufacturers. This section provides a summary of the results of the needs assessment.

### **Operational Needs**

The information obtained from fleet managers and owner-operators indicates that the strongest interest (nearly 75% in both cases) in IR technology is for systems that provide combined heating, cooling, and electricity. This interest stems from the fact that most trucks are operated in multiple areas of the country or areas that experience seasonal climatic changes. Interest in cooling or heating systems alone, a distant second in response, seems to only apply to trucks operating exclusively in northern (for heating) or southern (for cooling) climates.

About 50% of responding fleet managers track idle time and nearly 50% claim to use IR systems or techniques. Only 17% of owner-operators questioned track idling and 16% use IR systems. The principal reason owner-operators and fleets use IR technologies is economic—more than 90% of the respondents report saving fuel as a principal reason. Of those that use or have tried IR technologies, more than half report a good experience with reduced idle time, increased fuel economy, and reduced engine maintenance.

### **Barriers**

Owner-operators report that the primary barriers facing IR technologies are cost, reliability, maintenance requirements, and weight. Fleet managers report similar results but add that driver education, training, and receptiveness are notable barriers. Truck manufacturers also note that stronger interest in and pull for IR technologies from fleet customers are necessary to further adopt and implement IR technologies.

**Cost** is by far the biggest barrier with more than half of owner-operators and fleets reporting it as the number-one barrier to implementation. On average, fleets require a payback period of two years. Owner-operators allow a slightly longer period of two to three years, whereas truck original equipment manufacturers (OEMs) look at one year to 18 months for installed accessories. Typical calculations of savings are currently based only on fuel savings and do not include potential maintenance and engine life savings or possible increased resale values. According to IR technology manufacturer data, IR systems save \$1,500 to \$2,000/yr in fuel costs. Typical combined heating, cooling, electrical systems cost \$5,000 to \$7,000. As such, their payback period is roughly two-and-a-half to four years. Truck manufacturers

indicate fuel savings and reduced maintenance, and extended engine life could be measured via fleet operations using onboard data recording.

**Lack of driver education, training, and receptiveness to IR technologies** constitutes the second largest barrier category reported by fleet managers. In fact, this issue ranked as the number-one barrier by 32% of respondents. Fleet managers felt truck operators idle because they are unaware of the benefits of reduced idling or out of habit. Teaching drivers the importance and benefits of reducing idling is critical to making a case for IR technology use.

**Maintenance and reliability requirements**, or service intervals for the installed IR technology, should match those of the truck. IR technologies may require basic maintenance (oil and filter changes) every month or two, but the fleet minimum maintenance schedule for trucks and engines is 13,000 miles or about every three months. However, owner-operators have indicated that the vast majority of operators do maintenance on their trucks every month or two, eliminating the need for additional IR-specific maintenance. Truck life is about 10 years and 1 million or more miles, but the life of IR technology is typically three to seven years. However, large fleets and owner-operators typically keep vehicles only four to seven years, reducing some concern about the shorter IR system life, except for trade-in or resale value of the equipment.

**Weight** for combined heating, cooling, and electrical IR systems is about 300 lbs. to 400 lbs. According to truck manufacturers, IR systems should not exceed 100 lbs. to minimize any reduction in cargo carrying capacity and could benefit from a U.S. Department of Transportation weight exemption. Owner-operators do consider weight to be an issue (26% rank weight as the number-two barrier), but fleet managers do not (ranked eighth by 23%).

## Findings

An IR technology demonstration will focus on addressing the barriers to implementation. The most significant barrier is the initial cost and resulting payback period, which currently is too long to make a strong business case for fleets. The cost-benefit ratio of IR technologies can be improved by:

- Installing technologies on the factory production line
- Providing demonstrations to statistically quantify (to the satisfaction of fleet managers) the cost savings of IR technologies through reduced maintenance and extended engine life, as well as reduced fuel use
- Making volume purchases
- Providing tax credits for IR technologies and exclusion from the federal excise tax

Installing IR technologies on the truck while it is on the factory production line would reduce initial system cost by approximately \$1,000 and allow for an increased residual book value upon trade-in. Demonstrating and quantifying these cost savings (in addition to fuel savings), reduced engine maintenance, and extended life, would encourage fleet managers to include these benefits in their payback calculations, thus improving the business case.

Maintenance and reliability can be at least partly addressed by factory certification and production line installation. This factory certification should improve parts quality, availability, maintenance, and service. Another area to be considered is extending the maintenance intervals of the IR technologies to better match those of trucks.

A three-pronged approach to addressing the barriers to IR technologies appears appropriate.

- **Prong 1** should include fleet demonstrations to show economic advantages that emanate from fuel savings, maintenance reductions, and extended engine life, and to compile unbiased

information on the performance and service of IR technologies. These demonstrations are the focus of this plan.

- **Prong 2** should focus on cost reduction measures including production line installation by OEMs, volume purchases, and other incentives. These measures should result from successful fleet demonstrations.
- **Prong 3** would include research and development on various aspects of IR technologies, such as weight reduction, as an activity separate from this Demonstration Plan.

## **Phase 2 – Workshop for Industry Input**

As part of this project, the IR technology evaluation team will hold one or more workshops to solicit input from the trucking industry on the Demonstration Plan and review the framework for a forthcoming solicitation for demonstration projects (as detailed in Phase 3). The Demonstration Plan will be sent to industry representatives who have expressed interest in participating in an IR evaluation project. The plan will be available via the Internet, and announcements of the availability of the plan, as well as the upcoming workshop, will be submitted to several trade publications. The goals and objectives for the workshop are:

- Review results of initial needs assessment of Phase 1 and discuss the conclusions and recommendations from this activity. Determine whether the results, conclusions, and recommendations are accurate and appropriate.
- Analyze the Demonstration Plan and the proposed timeline. Answer these questions:
  - Will the demonstration results address the barriers to implementing IR technology?
  - Will the demonstration report results of in-service IR technology performance?
  - Will it quantify costs and measure potential cost savings?
  - Will it educate drivers about the advantages of using IR?
  - Will it provide the framework for developing a business case for truck manufacturer installation?
- Review the requirements of the solicitation for IR technology demonstration and evaluation. Input from the workshop will be used to finalize a request for proposal to be issued in 2003.

## **Phase 3 – Solicitation and Award of Demonstration Projects**

The demonstration and evaluation solicitation is intended to demonstrate the installation cost, operational cost savings (if any), and other benefits or shortcomings of current IR technology. The solicitation will require teams to propose a project that will install equipment onboard trucks that will operate in multiple locations with varying climates for one year. The onboard equipment shall provide stand-alone cabin heating and/or cooling and electricity for standard plug-in accessories (laptop computer, etc.). The teams should consist of a truck fleet or owner-operator, a truck manufacturer, and an IR technology manufacturer to ensure successful implementation and demonstration of the complete onboard IR system. Fleets that already have in-use IR technology data will also be considered.

Cost-shared Federal Financial Assistance Agreements will be awarded based on review of the submitted proposals by the IR technology evaluation team. In general, proposals will be evaluated against criteria for the technology chosen, fleet characteristics, experience of the project partners, data collection methods, and projects costs and cost share.

## **Selection of Technology**

The proposed technology may provide heating, cooling, and electricity. All onboard IR technologies will be considered, but the technologies and projects proposed with the greatest impact will be chosen first for demonstration and evaluation. Candidate selection criteria may include the following:

- Technology must be available for installation and demonstration.
- Manufacturers must be interested in and committed to developing and commercializing technology and participating in this project.
- IR technology must have the potential to significantly reduce in-vehicle engine idling/fuel consumption and emissions, taking into account the energy consumption, cost, and emissions of the IR technology.
- Manufacturers of IR technology should be willing to share costs.
- Market penetration of technology may be considered.

## **Selection of Fleet**

Fleets must consist of company-owned trucks or a group of independent owner-operators. The fleet selection criteria may include:

- Fleet must show strong interest in participating.
- Fleet should be willing to share costs.
- Fleet must provide appropriate characteristics for vehicle engine IR potential, such as size of fleet, vocation, and location.
- Fleet should have experience with IR technologies.
- Fleet must be interested in and able to provide required data collection.
- Fleet must be committed to operating, maintaining, and supporting IR equipment.
- Fleet must have suitable trucks for retrofit (i.e., support from truck manufacturers) or buy trucks that will be equipped with IR technologies by a participating truck OEM.

## **Selection of Team**

The following criteria apply to teams proposing to conduct IR technology evaluation projects:

- Previous team experience on truck or idling issues will be considered.
- Team should consist of a truck fleet, a truck OEM with engine manufacturer support, and an IR technology manufacturer.
- Team should be willing to share costs.

## **Phase 4 – In-Use Evaluations**

The IR Technology Demonstration and Evaluation Project will require a substantial data collection effort. Once the onboard IR system has been installed, and vehicles enter revenue service, operational data must be collected on demonstration and control vehicles (without IR technology) for comparison. The demonstration project data needs are identified in Table 4. The specifics of how the data are actually recorded and collected will be proposed by the bidders/participants and will be finalized after discussion with the fleet representative and the drivers involved. The program will attempt to integrate these efforts with other ongoing fleet data collection efforts by team members in the simplest and most cost-effective manner possible.

Automated data collection is preferred. For example, it is preferable to keep an automatic run-time log on the IR technology instead of having the driver manually record when and for how long the device operates. During the data acquisition phase, the demonstration team will periodically check on the data collection. Questions to consider include:

- Are the right data being collected?
- Are there better ways to collect the data?
- Are there alternative data that might be superior?
- Are the data behaving as expected?

Based on this review, course corrections may be made.

At the end of the in-use evaluation phase, all the data will be assimilated, analyzed, and documented in a report by the IR demonstration project team. Types of analyses will include a determination of actual costs and savings compared with advertised and predicted costs and savings. Also documented will be lessons learned on acquiring data from fleet operations and reliability of the technologies. Results from this effort will also be used to lay the groundwork for further demonstrations, presentations to industry and trade groups, etc. The team recognizes that this first demonstration effort constitutes a very small sample, and large extrapolations may be difficult if not unwise. The in-use evaluation will, however, provide some definitive real world data that can be used to answer certain questions, provide direction for future demonstration activities and develop meaningful communication between truck owner-operators, manufacturers, technology providers, and the government.

**Table 4. IR Technology Demonstration Data Items**

Type of Data	Frequency Recorded	Data Items
IR Technology Specifications and Initial Costs		
IR System Descriptions	Start of data collection and changes as needed	Detailed description of installed system
IR System Capital Cost	Start of data collection and changes as needed	Total cost for IR system
IR System Installation Costs	Start of data collection and changes as needed	Cost of installation including: labor time and rate, and travel time to shop
Vehicle Operation		
Vehicle Operating Cycle	Start of data collection and changes as needed	General description of daily use of vehicles, more detailed information if available
IR System Usage in Service	Each time IR system is used	Start and stop time
		Purpose of idle time
Fuel Use at Idle	Start of data collection	Parasitic brake horsepower and engine RPM at various load combinations
Fuel Consumption	Each time a vehicle is fueled	Amount of fuel
		Odometer reading
	Date	
	Each time the fuel price changes at a given site	Price per unit
Noise Level	Start of data collection	Standardized decibel measurements taken at various load conditions
Engine Oil Consumption and Changes	Each time oil is added	Amount of oil
		Odometer reading
		Date
	Each time oil is changed as recommended by the engine manufacturer	Price per quart
		Amount of oil
		Odometer reading
Date		
Maintenance	For each work order	Type of maintenance: scheduled, unscheduled, road call, configuration change
		Labor hours
		Date of repair
		Number of days out of service
		Odometer reading
		Parts replaced
		Parts cost
		Description of reported problem
		Description of repair performed
Other Information Needed Evaluate IR Technology		
Engine Overhaul Costs	Start of data collection	Cost of engine overhaul
		Frequency of engine overhaul
Truck Emissions at Idle	Start of data collection	Record historical or engine manufacturer data
IR Technology Emissions	Start of data collection	Record data from technology OEM
Resale Value	End of demonstration	Value of vehicle
User Satisfaction	Monthly and at end of demonstration	Record impressions and observations of driver

## **Phase 5 – Data Analysis and Dissemination**

The initial needs assessment (Phase 1) identified some key barriers to implementing IR technologies. These barriers included initial equipment cost, driver receptiveness, and equipment reliability and maintenance. The strategy to overcome these barriers is twofold: 1) demonstration and evaluation to address cost and technology, and 2) effective education and communication with the ultimate users to address driver receptiveness.

The results of the evaluation should quantify cost, reliability, and service barriers identified in the initial needs assessment as well as identify other possible issues with IR use. The evaluation must determine, document, and present the actual costs and savings associated with IR technology use as applied to several fleet applications. The evaluation report should examine the calculated payback period of initial costs and the corresponding business case to develop solutions for successful technology implementation. Regardless of the outcome of the evaluation, all results will be published, and these results will determine the next steps for the plan.

DOE will work with established information and training outlets to communicate the results of the project. Trucking firms, owner-operators, OEMs, and drivers will all need information about these technologies, each with a different point of view. To educate these ultimate users, information, data results, and reports must be communicated through all appropriate channels, including trade organizations and shows, major trucking organizations, and the Internet. DOE will disseminate and release information to trade media for inclusion in trade publications, the highest reported source of information on truck technologies for the trucking industry.

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13. ABSTRACT (Maximum 200 words) The purpose of the Demonstration Plan is to define a pathway to IR technology implementation and use by addressing these issues. The intended outcome of this demonstration and evaluation is to identify and remove barriers for the targeted use of IR technologies in trucking applications. Positive results will encourage truck operators to demand these systems and motivate truck manufacturers to integrate and install IR as standard equipment.				
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